Amendments to the Description:

Please replace the entire Summary of the Invention Section beginning at page 3, line 30 to page 4, line 31, with the following amended paragraphs:

In accordance with a first aspect of the present invention, there is provided an ~~method~~ apparatus for humidifying ~~a~~ first and second process gas streams, the ~~method~~ apparatus comprising ~~the steps of~~:

(a) ~~super-saturating and heating the process gas stream with steam until it reaches a first pre-set temperature~~a steam supply line;

(b) ~~cooling the process gas stream until it reaches a second pre-set temperature~~a first humidification unit having an inlet for the first process gas stream and a first steam supply means connected to the steam supply line, for supplying steam into the first process gas stream, to add humidity to the first process gas stream at a first temperature, to a humidity well in excess of a required humidity level;

(c) ~~removing excess condensed water from the process gas stream; and~~a first heat exchanger connected to the humidification unit, for cooling the process gas stream to a second, lower temperature, whereby excess moisture in the first process gas stream condenses;

(d) ~~heating the process gas stream until it reaches a third pre-set temperature.~~a separator connected to the first heat exchanger, for removing the condensed moisture, whereby the first process gas stream leaving the separator has a known temperature and a known humidity level;

(e) a first heater connected to the separator, for heating the first process gas stream to a third temperature, greater than the second temperature, whereby the process gas stream has a known absolute humidity level;

(f) a second humidification unit including an inlet for the second process gas stream and a second steam supply means connected to the steam supply line, for supplyling steam into the second process gas stream, to add humidity to the second process gas stream at a fourth temperature, to a humidity well in excess of a required humidity level;

(g) a second heat exchanger connected to the humidification unit, for cooling the second process gas stream to a fifth, lower temperature, whereby excess moisture in the second process gas stream condenses;

(h) a second separator connected to the second heat exchanger, for removing the condensed moisture, whereby the second process gas stream leaving the second separator has a known temperature and a known humidity level; and

(i) a second heater connected to the second separator, for heating the second process gas stream to a sixth temperature, greater than the fifth temperature, whereby the second process gas stream has a known absolute humidity level;

wherein the first heater comprises a third heat exchanger and, wherein each of the first and third heat exchangers is provided with a corresponding first temperature control circuit for controlling the temperature of the corresponding heat exchanger and including a conduit for a fluid, a pump for pumping the fluid and a first cooling means having connections for a first coolant supply, with a first common coolant supply being connected to both of the first cooling means; and

wherein the second heater comprises a fourth heat exchanger, wherein each of the second and fourth heat exchangers is provided with a corresponding second temperature control circuit for controlling the temperature of the corresponding heat exchanger and including a conduit for a second fluid, a pump for pumping the second fluid and a second cooling means having connections for a second coolant supply, with a second common coolant supply being connected to both of the second cooling means.

In accordance with another aspect of the present invention there is provided an apparatus for humidifying a process gas stream, for a fuel cell, the apparatus comprising:

(a) a steam supply line;

(b) a humidification unit having an inlet for the process gas stream and a steam injector connected to the steam supply line, for injecting steam into the process gas stream, to add humidity to the process gas stream at a first temperature, to a humidity well in excess of a required humidity level;;

(c) a first heat exchanger connected to the humidification unit, for cooling the process gas stream to a second, lower temperature, whereby excess moisture in the process gas stream condenses;

(d) a separator for removing the condensed moisture, whereby the process gas stream leaving the separator has a known temperature and a known humidity level; and

(e) a second heat exchanger connected to the separator, for heating the process gas stream to a third temperature, greater than the second temperature, whereby the process gas stream has a known absolute humidity level;

(f) a first temperature control circuit, for controlling the temperature of the first heat exchanger, the first temperature control circuit comprising a first conduit for a first fluid, a first pump for pumping the first fluid, and a first cooling means for cooling the first fluid, with the first heat exchanger being located in the first conduit;

(g) a second temperature control circuit, for controlling the temperature of the second heat exchanger, the second temperature control circuit comprising a second conduit for a second fluid, a second pump for pumping the second fluid, and a second cooling means for cooling the second fluid, with the second heat exchanger being located in the second conduit; and

(h) a common coolant supply connected to the first and second cooling means.

A further aspect of the present invention provides an apparatus for humidifying a fuel gas stream and an oxidant gas stream for a fuel cell, the apparatus comprising:

a fuel gas humidification unit having an inlet for the fuel gas stream and a first steam injector, for injecting steam into the fuel gas stream, to humidify the fuel gas stream at a first temperature to a humidity well in excess of a required humidity level;

a first, fuel gas heat exchanger connected to the fuel gas humidification unit, for cooling the fuel gas stream to a second, lower temperature, whereby excess moisture in the fuel gas stream condenses;

a fuel gas separator connected to the first fuel gas heat exchanger, for removing the condensed moisture from the fuel gas;

a second, fuel gas heat exchanger connected to the fuel gas separator, for heating the fuel gas stream to a third temperature, greater than the second temperature, whereby the fuel gas stream has a known absolute humidity level;

an oxidant gas humidification unit having an inlet for the oxidant gas stream and a second steam injector, for injecting steam into the oxidant gas stream, to humidify the oxidant gas stream at a third temperature, to a humidity well in excess of a required humidity level;

a third heat exchanger connected to the oxidant gas humidification unit, for cooling the oxidant gas stream to a fourth, lower temperature, whereby excess moisture in the oxidant gas stream condenses;

an oxidant gas separator connected to the third heat exchanger, for removing the condensed moisture, whereby the oxidant gas stream leaving the second separator has a known temperature and a known humidity level; and

a fourth heat exchanger connected to the oxidant gas separator, for heating the oxidant gas stream to a sixth temperature greater than the fifth temperature, whereby the oxidant gas stream has a known absolute humidity level;

wherein a first heater comprises a third heat exchanger and wherein each of the first and third heat exchangers is provided with a corresponding first temperature control circuit for controlling the temperature of the corresponding heat exchanger and including a conduit for a fluid, a pump for pumping the fluid and a first cooling means having connections for a first coolant supply, with a first common coolant supply being connected to both of the first cooling means; and

wherein the second heater comprises a fourth heat exchanger, wherein each of the second and fourth heat exchangers is provided with a corresponding second temperature control circuit for controlling the temperature of the corresponding heat exchanger and including a conduit for a second fluid, a pump for pumping the second fluid and a second cooling means having connections for a second coolant supply, with a second common coolant supply being connected to both of the second cooling means.

In one embodiment, the method further comprises the step of maintaining the third pre-set temperature of the process gas stream from step (d) until it reaches an inlet of a fuel cell.

In accordance with another embodiment of the present invention, there is provided an apparatus for humidifying a process gas stream for an operating fuel cell, the apparatus comprising:

(a) a means for super-saturating and heating the process gas stream with steam until it reaches a first pre-set temperature;

(b) a means for cooling the process gas stream until it reaches a second pre set temperature;

(c) a means for removing excess condensed water from the process gas stream; and

(d) a means for heating the process gas stream until it reaches a third pre-set temperature.

In one embodiment, the apparatus further comprises a means for maintaining the third pre-set temperature of the process gas stream from step (d) until it reaches an inlet of a fuel cell.

The present invention has many advantages over the prior art. The combination of the dewpoint cooling section and reheating section allows rapid changes in operating conditions, with response times that are less than 30 seconds. Furthermore, the system can be dynamically controlled to provide precise and accurate inlet fuel process gas stream temperatures and relative humidities, which are both essential for the efficient operation of a proton exchange membrane fuel cell over a wide range of current densities.